TELEVISION TODAY

By FRED W. WENTKER

Manager, Sales and Advertising Division,
RCA Service Company, Inc.

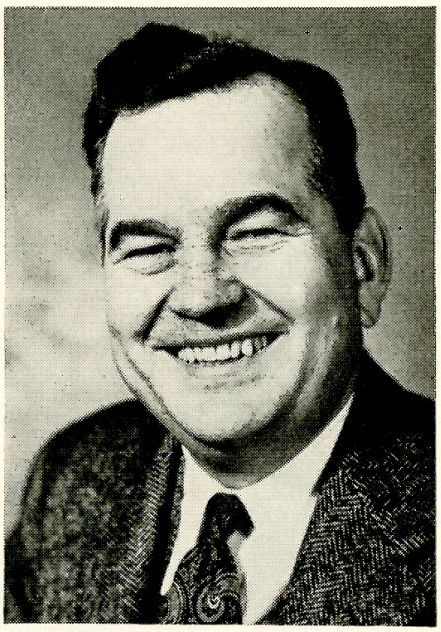
BECAUSE in the past the adequacy of television's technical standards, the economics of television broadcasting and the the importance of color television were so hotly contested in engineering circles, in public hearings and in the press, comparatively few persons outside of the television engineering fraternity have been made aware of the tremendous accomplishments in the way of equipment and techniques used for the transmission and reception of present-day television programs.

When commercial television made its prewar debut, much of the equipment had just emerged from the research stage. Although it was capable of excellent picture results under favorable conditions and was quite satisfactory from the standpoint of reliability (much of it is still operating today), it lacked the flexibility to meet modern showmanship standards. The cameras, for example, lacked the portability and versatility of motion picture camera equipment. Because the camera tubes were relatively insensitive, large aperture lens often had to be employed under conditions where the resulting lack of focal depth proved a serious detriment. Techniques, too, suffered by comparison with those of the motion picture because of equipment limitations. These are but some of the phases of prewar television where improvements were badly needed.

Television Advances

What has been accomplished during the intervening years? Does today's television equipment reflect the great forward strides one expects in a field which is so closely linked to wartime electronic developments? Does its flexibility compare with that of contemporary entertainment and news services? An examination of the various apparatus units and the ways in which they are adaptable to the needs of modern telecasting will show that the answer is strongly affirmative.

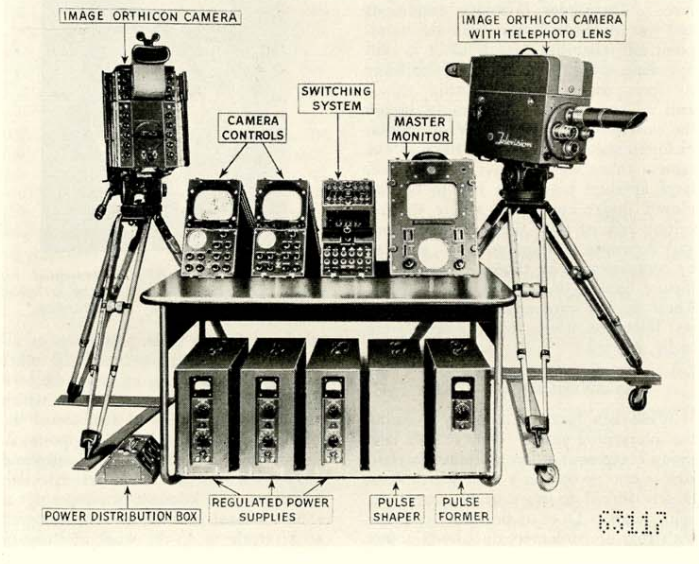
Since television must be a line-of-sight service to be reliable, the height of the transmitting antenna is tremendously important. The higher it is, the farther away is its horizon; consequently the larger will be its service area. There is only one Empire State Building in all of the U. S. A. In practically all other locations the radiating elements must be supported on a tall mast or tower which may project hundreds of feet above the building or terrain which supports it. Light weight and the ability to withstand heavy wind and ice loads are essential.



Fred W. Wentker, BS '27 presented his talk, "Television Today," at the technical session of the 1947 Homecoming.

The cost of a kilowatt of picture signal is not inconsequential; if one kilowatt can be made to do the work of three or

1.



2.

four or more, so much the better. An antenna that compresses most of the signal into a relatively small angle that encompasses the horizon would be an ideal arrangement. No practical system is quite that good, but at least one goes a long way in that direction.

The television transmitting antenna must have a wide pass band. This is to insure picture fidelity and make possible the use of a single set of elements for both picture and sound signals.

A system that meets these various requirements in admirable fashion is the RCA Super Turnstile antenna. By using stacked arrays, high power gains are achieved. For channels 2-6, three bays are used to develop a power gain of 3.5 to 4.5. For channels 7-13, the elements are appreciably smaller, hence, a six bay arrangement is practical; and the power gain, therefore, varies from 7.2 to 8.6. Thus 5 kw of transmitter output is made as effective as though 17.5 to 43 kw (depending upon the particular band in use) were radiated from an antenna with a purely non-directional pattern. Since its pass band is unusually wide it readily serves both sound and picture transmitters. A suitable "diplexer" network in the feed system prevents one transmitter from affecting operation of the other.

Earlier the point was made that a high gain antenna system minimizes transmitter power requirements. For this reason, today's television transmitters do not run to high power, 5 kw being adequate for most situations. Two completely separate transmitters may be used or they may be housed in a single construction as in the case of the RCA TT-5 which provides an interesting example of modern television transmitter design. Both electrical and mechanical design of this unit meet or excel the highest standards of radio transmitter design.

1.
This mobile unit, which carries all the equipment required for a two-camera set-up, can be taken directly to the scene of action where sports or news events can be picked up and relayed to the broadcast station by a microwave transmitter.

2.
This two-camera equipment is ideal for field program pickups, and may also be used for studio programs. The cameras feature high sensitivity, large depth of focus, and generally uncritical operation.

New Tube Developed

Both sound and picture sections of this transmitter use the newly developed RCA 8D21 twin tetrode in their output stages. This tube is a marvelous triumph of electronic, mechanical, and thermodynamic engineering. Its plate-to-plate capacity, only about 2mmf, is as low as that of a small receiving tube. Though the plates are only slightly larger than postage stamps, they readily dissipate the high power involved. This tube is used for the highest band as well as the lowest. It is truly the heart of the transmitter.

A study of a modern television field camera system shows better than anything else how far television has moved ahead. Today's most advanced television camera has a four-lens turret. A switch from one lens to another, including refocusing, can be made easily in 1½ seconds. Thus, even a single camera can handle smoothly a wide range of action. By adding one, two, or three more cameras together with a selective switching system, a choice array of shots may be blended into a smooth continuity having a maximum of entertainment value. To accomplish the same effect with motion picture photography, one would have to load each camera with its own film, then cut and splice them together to make up the final continuity. In television the equivalent effect is secured instantaneously by merely switching the camera outputs electrically.

Today's television camera is also equipped with an electronic viewfinder which uses a small kinescope to supply the cameraman with an exact copy of the camera lens image. Parallax errors therefore are impossible; and because the television camera's pickup system is ultra-sensitive, the electronic viewfinder is

workable under light conditions where a mere optical unit is quite useless.

The heart of this camera is its picture tube, the RCA Image Orthicon. This remarkable device, a product of wartime research, effects three transformations: an optical image into an electron image; electron image into charge pattern; and charge pattern into a modulated electron stream carrying the picture information. A built-in, five stage electron multiplier and its inherent sensitivity produce an overall output 100 times that of the Iconoscope.

Auxiliary Units

If one were to build into the camera's own housing the necessary power supply equipment and the generators for supplying the horizontal and vertical driving signals, synchronizing signals and kinescope blanking signals, the result would be an unwieldy piece of apparatus. A much more satisfactory solution is to use one external synchronizing generator for an entire group of cameras, and separate external power supply and camera control units for each camera. In the latter are placed amplifiers for stepping up the amplitudes of the driving signals, picture signal amplifiers, picture and wave-form monitors, etc. When more than one camera is used, a selective switching unit is added. In this latter unit the receiver synchronizing and kinescope blanking signals are mixed with the picture signal from the camera. (When only one camera is used, this may be accomplished in the camera control unit.)

In operation, these auxiliary units are all grouped at one point. Here the program director, by watching the scenes being portrayed by the monitoring kinescopes, continually selects the one to be passed on to the transmitter. Only the easily portable cameras, which can operate at the end of a cable as long as 1000', need be taken to the vantage points where the program is to be picked up.

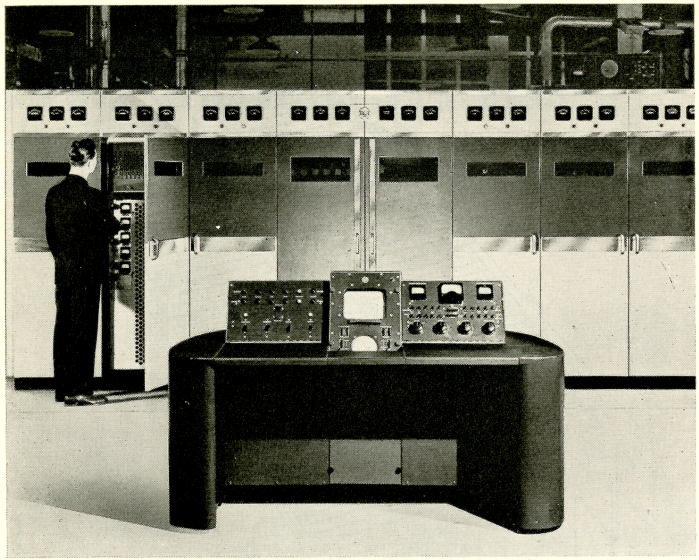
For outside program pickup a specially designed mobile unit adds immensely to the ease with which the job may be handled. In most situations such a unit can be brought to within 1000' of the camera locations, hence, the control equipment usually can remain in the mobile unit which then functions as the control room. The top deck of such a unit also serves as a convenient camera platform in many instances.

It should be apparent by now that there are few events that cannot be successfully brought into focus by the lens of the television camera. Whether it be a profoundly serious situation, such as a delicate operation, or a hilarious entertainment event, television takes them all in its stride. In fact, so smoothly does today's system function in the hands of thoroughly seasoned operators that few people watching an event at the receiver end of the chain are even remotely conscious of the way in which the pickup is continually shifting from camera to camera, from close-up to long shot, etc.

In a baseball broadcast, for example, two cameras are usually used. The preferred position is directly behind home plate, with one camera high up in the stand and the other fairly well down. The lens equipment is usually selected from about seven gradations in focal length ranging from 50 mm for full field shots to 610 mm telephoto lens for closeups, score-board shots and "color" shots. Whether it's a close play at home plate, a spectacular catch in the outfield or a brawl over a disputed decision, the viewer is put right at the spot where he can view the action to best advantage.

Use Radio Relay Link

Although there are some instances where special coaxial transmission circuits or specially balanced telephone lines are available for delivering the program to the transmitter there are many more where television would be hamstrung were it not for the availability of a radio relay link. For this purpose, a low power transmitter operating in the centimeter wavelength range is ideal. By using highly directive, parabolic reflectors at both transmitting and receiving ends, an extremely selective transmission path is



This RCA TT-5 television transmitter is really two transmitters. One transmits the television picture, and the other the accompanying sound. The transmitter console in the foreground is the control center.

established. This results in the exclusion of noise and extraneous reflection signals. Since the power gain of a four foot parabolic radiator at this frequency is about 5000, a 100 milliwatt transmitter is made as effective as 500 watts fed into a non-directional radiator.

Receivers, likewise, have made noteworthy forward strides. Today's receivers are capable of tuning in any of 13 television channels. Picture brightness and detail have been improved. Synchronizing circuits have been perfected so that loss of synchronization is virtually unknown. Every known means for making receivers more efficient has been incorporated. For years the meat packing plant, claiming to use everything except the pig's squeal, has been looked upon as the ultimate in efficiency. Television receiver engineers have gone them one better. They have put the "squeal" to good use by recovering the reactance energy in the kinescope's horizontal deflection circuit—which otherwise would be wasted—to furnish its own anode voltage. Whether one's taste may run to a table model, a console, or a deluxe combination instrument with television, AM and FM radio, and phonograph; there is an instrument available today to satisfy it.

Thus, thanks to the many remarkable improvements in equipment and techniques, television has made enormous advances since its prewar debut. It is well on its way towards fulfilling its manifest destiny as one of man's most important services. It has already expanded and reshaped the communications and entertainment spheres of many. Before long, its influence will be felt and enjoyed by all.

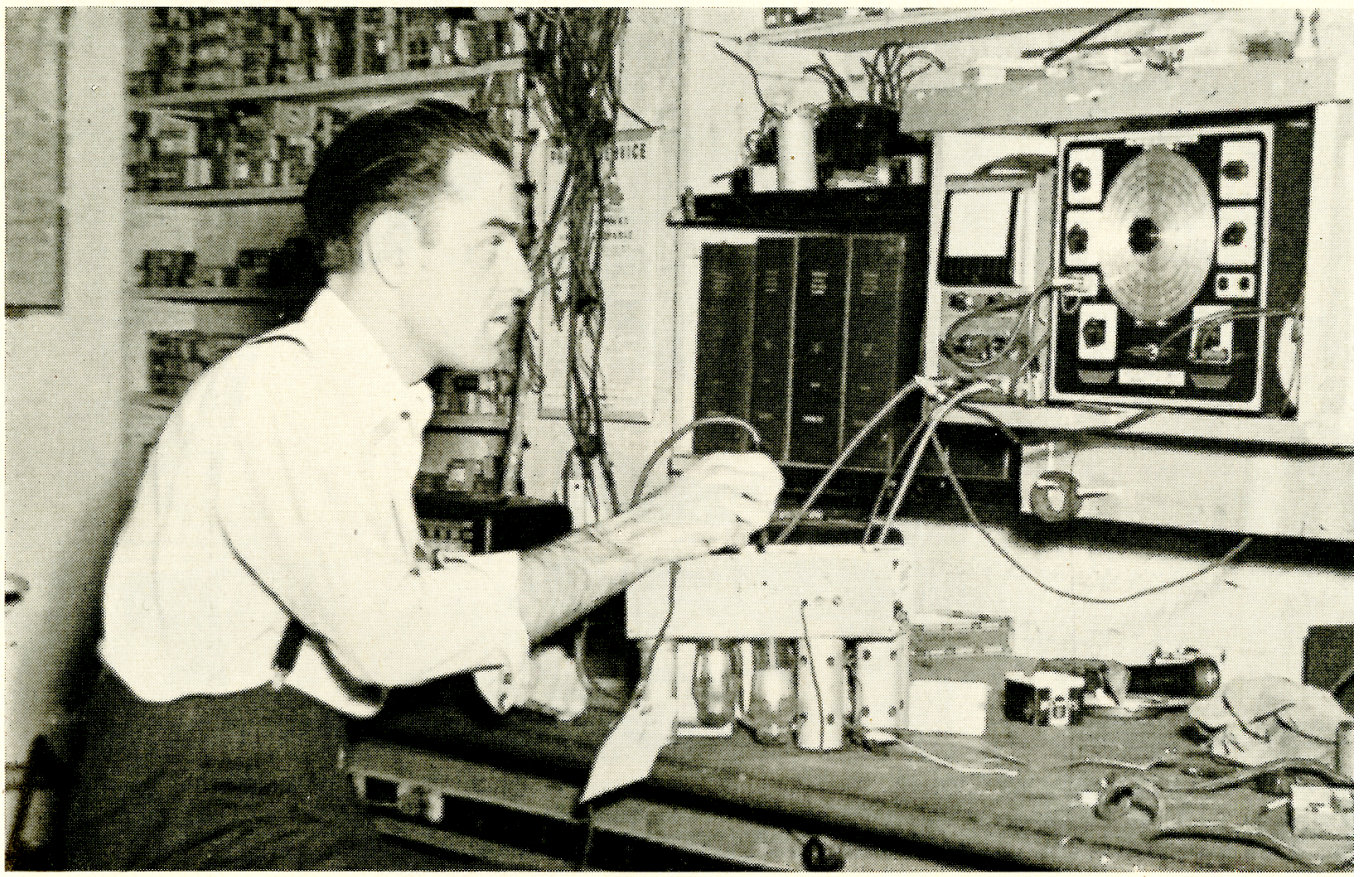
MSOE Students at Work

To supplement government allowances and to meet the cost of living expenses while at school, many MSOE students perform part-time work at various Milwaukee industries.

Many hold jobs which are closely allied to the subjects they are taking at school, thus gaining valuable experience for work after graduation. Others are working in types of jobs not related to their school studies, but which are necessary to meet current expenses. All types of work offer training and experience that will benefit the graduate.

In this issue the *Transmitter* has selected a representative group of MSOE students at work to illustrate the various types of jobs being performed.

Appreciation is extended to the companies where these men work for their cooperation in making these pictures possible.



Joseph Worm, Electro Tech Term IV, works at the United Radio and Appliance Company, 1026 E. Brady. His job is that of a radio and telephone repairman. His work ties in well with his school subjects because he is training to become a radio technician.